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Nebraska Public Power District

Customer Owned Generation Application Manual

This document contains the interconnection requirements for Customer-Owned Generation that operates in parallel with NPPD's Distribution System.

This document is subject to change by NPPD without notice to Customer. Last updated 2/21/2024.

1.0 PURPOSE

This document provides process direction to both the District colleagues internally (Customer Service, Operations, Asset Management, etc.) and District's customers externally (Retail, Wholesale, End-Use) to design and specify the requirements of the Nebraska Public Power District (District) for the connection of Customer Generation (CG) to the District electric system. Customer Generation (CG) refers to Retail and Wholesale Distributed Generation (DG) as well as community Local Generation (LG) facilities. This document will provide the necessary process path to implementation of customer generation and provide the technical specifications of the generation connection.

2.0 SCOPE

This document applies to the connection of Customer Generation facilities that:

- Connect to or impacts Transmission, Subtransmission and/or Distribution facilities owned and/or operated by the District; and
- Operate or may be programmed to operate in parallel mode (also known as closed transition) with the District's system.

This document excludes:

- Customer Generation systems that physically cannot operate in parallel mode but can only operate in an isolated mode (also known as open transition);
- Any rate or pricing provisions such as: energy export prices or customer terms and conditions.

The requirements are intended to achieve the following:

- Ensure the safety of the general public and District personnel; permit the Customer Generation facility Owner (or 'Owners') to install and operate generating equipment in parallel with the District.
- Minimize adverse operating conditions on the District electric system and existing customers.
- Develop a systematic, non-rate discriminatory statewide process.

3.0 CONNECTION APPLICATION PROCESS

The application process is the series of prescribed steps to be taken by the Interconnection Customer who desires to connect with the NPPD's electric system, which includes connection directly to Transmission, Subtransmission, or Distribution facilities owned and/or operated by NPPD, as well as connection of parallel operated generation 500 KW or greater that is connected to another utility's facilities interconnected with NPPD (since this

may also impact NPPD's electric system). NPPD requires information such as location, technical and design parameters, and operational and maintenance procedures.

From a standard process perspective, two primary paths determine the applicability of the implementation direction:

- Retail connections with 25kW nameplate or less
- Retail or wholesale connection greater than 25kW

This standard excludes all connections of generators of 10,000 KW or greater due to registration process required by Southwest Power Pool (SPP), the NPPD's regional transmission organization. All connections meeting this characteristic should be referred to SPP.

Interconnections that create flow and stability issues that impact the Transmission System and/or are greater than 5,000 KW will be required to comply with the NPPD **Facility Connection Requirements** document and fill out Attachment 1 NPPD Generator Interconnection Data Request Form. All generators greater than 5,000 KW must be reported to SPP as per Business Practice Revision BPR0018 Guideline for determining jurisdiction of SPP Generator Interconnection Procedure. This process is intended to be clear, concise but at the same time ensure the safety of the general public and District personnel.

The application manual includes the steps that must be taken to properly account for site-specific concerns and address the technical and procedural requirements of the connection standard. In some cases, the District may reject the proposed Customer Generation project connection for reliability or safety issues.

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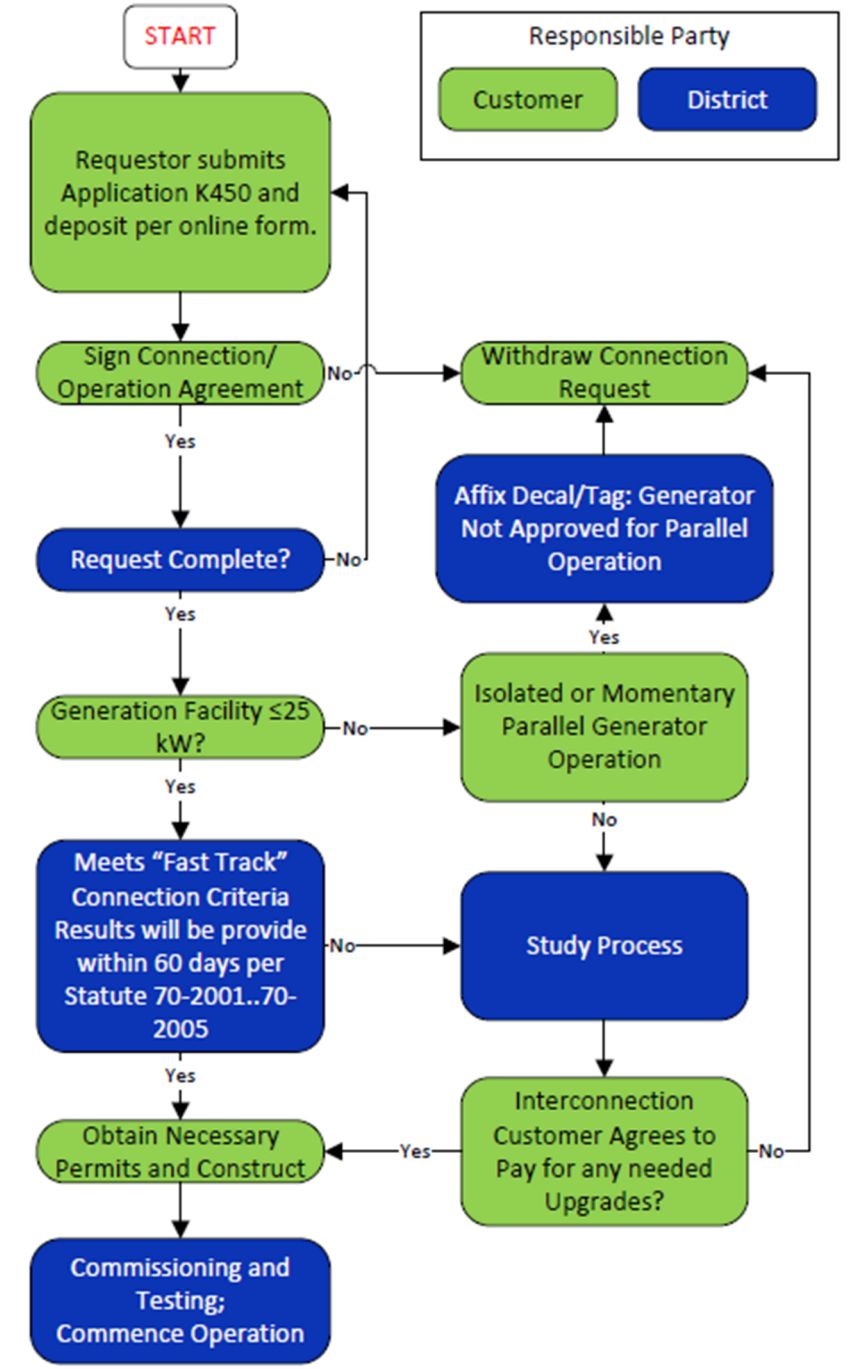
Customer Owned Generation Application Process



4.0 RETAIL, WHOLESALE, OR LOCAL CONNECTIONS FOR GENERATORS > 25 KW

4.1 Supplemental Documentation:

As needed, complete supplemental document, NPPD Generator Interconnection Data Request Form, for connections that:

4.1.1 Interconnections that create flow and stability issues that impact the Transmission System and/or,

4.1.2 Interconnections greater than 5,000 KW will be required to comply with the Facility Connection Requirements document and fill out Attachment 1, NPPD Generator Interconnection Data Request Form.

5.0 CLASSIFICATION OF CUSTOMER GENERATION CONNECTIONS

The District categorizes connected (parallel) generation into four general classifications. These are Class 0, I, II, and III. The major factors to be considered in the determination of the connection class include the point of utility connection, the generator ratings, the generation type, and the number of generators connected on the electrical system. The District, based upon Customer Generation facility application information provided by the facility Owner, determines classification of the facility.

5.1 Class 0

This classification includes induction generators or generators with line commutated power converters rated 25 KW or below, single-phase.

5.2 Class I

Consists of all other induction generators or generators with line commutated power converters rated greater than 25 KW, except those determined to require a Class II connection, and any other generating equipment that must be energized by the utility system to operate (excluding microturbine type generation). The Customer Generator Owner must furnish VARS equal to a minimum of 90% of the estimated reactive requirement of the generator installation.

The District will determine requirements for protective functions/relaying on a site-specific basis. Connections disconnect and breaker is required.

5.3 Class II

Class II connections include generation equipment that operates independent of the utility, with rated capacity at or below 5,000 KW, and is connected to the utility at or below 15,000 volts.

Connections with synchronous generators or generators with self-commutating power converters are typically defined as Class II connections. Class II connections also typically apply to the connection of direct energy converters, most inverters, induction generators with an adequate local VAR supply, and all microturbines (whether capable of operation independent of the utility or not).

The Customer Generation facility Owner must purchase, install, and maintain the required protective equipment (see 'Protective Equipment' in this standard) for all Class II connections. This equipment includes:

- A visible disconnect at each connection point.
- A breaker for each connection point.
- Protective functions/relaying in accordance with District requirements.

The District may waive the connection breaker and protective relaying requirements for 'momentary' closed transition connections—refer to the definition of 'Duration of Parallel Operation' in the Glossary of this standard to determine if the load transfer equipment meets the 'momentary' classification.

5.4 Class III

Class III connections are for any connection in excess of 15,000 volts, but not to exceed 69,000 volts, or for generation with a capacity in excess of 5,000 KW. The District will evaluate and specify the requirements for Class III connections on a site-specific basis. Class III connections may require, as a minimum, all requirements for a Class II connection.

Class III facilities exceeding the above-mentioned upper limitation of 69,000 volts will require a connection directly to the District Transmission system; see Policy LGI, Large Generator Interconnection, for additional requirements.

NOTE: Customer Generation facilities may not be able to meet District Customer Generation requirements at certain points in the Customer Generation facility system. The Customer Generation facility Owner must verify the connection point with the District during the design stage.

6.0 LOCAL REGULATORY COMPLIANCE

It is the responsibility of the Customer Generation facility Owner to obtain any and all permits and jurisdictional approvals and to comply with all applicable codes such as National Electric Code (NEC), National Fire Protection Association (NFPA), etc.

NOTE: All open transition switchgear (either automated or manual via a transfer switch) capable of closed transition operations must meet NEC requirements and must be installed by a qualified licensed electrician.

For Class III Customer Generation facilities, NPPD will require documents submitted to bear the stamp of a Professional Electrical Engineer registered in Nebraska showing compliance with standards under the National Electric Code, National Electric Safety Code, Institute of Electric and Electronic Engineers and the Underwriters Laboratory. For Class II Customer Generation facilities, NPPD may require documents bear a Professional Electrical Engineer stamp, as appropriate.

This standard does not provide specific connection expense cost data to the Customer Generation facility Owner. As proposed, Customer Generation facilities must be evaluated on a case-by-case basis. The District will examine the impact of a proposed facility and evaluate costs for District system modifications, Customer Generation facility service modifications, or other required action during the 'application' phase. Specific connection expense cost data will be addressed during this process.

6.1 Responsibility

The District is not liable or responsible for Customer Generation Owner's equipment or the Customer Generation facility electrical system (or the protection of either). The Customer Generation facility Owner is solely responsible for protecting its equipment to prevent damage from faults, imbalances, out-of-phase reclosing, or other disturbances on the District system. Additionally, the Customer Generation Owner will be responsible to protect District property, District personnel, and the general public due to failure of any Customer Generation system equipment.

7.0 REQUIREMENTS FOR PARALLEL OPERATION

Any operation of generation in closed transition with the District system requires signed and executed application and agreements as deemed applicable by the District. The District must inspect and approve the installation for parallel operation. Parallel operation without a signed agreement, or failure to comply with the terms of the agreement, may result in termination of the utility service.

Upon review of the Customer Generation applicant's design for the proposed parallel installation, the District may require changes to the protection scheme, connection point, or other items. The District will notify the applicant, in writing, of approval of the 'Application for NPPD Approval to connect Customer Generation'. Any work performed prior to approval is deemed to be at the Owner's risk.

7.1 Testing and Examination

See 'Protective Equipment' in this standard for testing and verification schedules for protective equipment.

The District requires periodic testing and verification of all Customer Generation utility connections. The test(s) will verify the connection functions as originally approved by the District. The connection equipment will be tested for conformity with the initial 'as

installed' test requirements, and per all requirements of IEEE 1547 Series of Standards and pass all applicable NESC codes.

For momentary parallel, the Customer Generator must demonstrate the generator will disconnect from the system within 100 milliseconds, according to IEEE Standard 1547.1.3. The District reserves the right to affix a decal to the generator, identifying it does not qualify for parallel operation.

The test results of the customer owned generation will be validated by a licensed Professional Engineer in the state where the project is being constructed or a 3rd party qualified metering technician. The Engineer or 3rd part Metering Technician will be selected by the Customer Generation facility Owner and all services will be performed at the Owner's expense. The Customer Generation facility Owner will also reimburse the District for the direct, actual expenses incurred by the District as a result of testing. An example of such expenses would be reimbursement for a District crew or technician to 'stand by' during testing to be available in the event problems arise.

The Customer Generation facility Owner must keep all test results on file for review by the District.

7.2 District Access to Customer Generation Facility Equipment

Owner agrees to allow the District access to the Customer Generation facility under both normal and emergency conditions for the purpose of inspection and witness testing and application of safety/operation decals to the connection equipment. Emergency conditions may require District access to the Customer Generation facility without advance notice.

The District has the right to require the Customer Generation Owner to immediately disconnect the generation facility connection without advance notice or liability if:

- There are any changes or alterations to the Customer Generation facility equipment unapproved by the District.
- In the District's sole judgment, the facility has not incorporated necessary features for automatically counteracting the effect of anticipated possible sources of failure (fail-safe design).
- It causes any electrical problem(s) with other District customers.
- May pose a risk to District employees, customers, or the general public.

The failure of the Customer Generation Owner to comply with any of the covenants or obligations contained herein gives the District the right to terminate its agreement with the Customer Generation Owner and to recover from the Customer Generation Owner the cost and expenses incurred by the District.

The above clause is applicable to all customer generation operating in parallel with the District system, including generation discovered to exist on the District system without the

Customer Generation Owner having initiated or successfully completed the District approval process for Customer Generation installations.

8.0 TECHNICAL REQUIREMENTS

This section clarifies the technical requirements for connecting Class 0, Class I, Class II, and/or Class III generators to the District electric system.

8.1 Overview

8.1.1 Adverse Effect

The utility Customer Generation connection must not adversely affect the utility's other customers. Possible adverse effects to other utility customers include (but are not limited to):

- Reduction in quality of electric service.
- Higher cost of electricity.
- Expenditure of District capital for connection without benefit to other customers.

8.1.2 Connection Hazards

Proper operation of two independent power sources such as the utility source and a non-utility generation source in closed transition results in a parallel operation of the two systems. The electrical attributes of both systems must be identical prior to and during the period of parallel operation. Any attempt to connect the two power systems while they do not share identical attributes will result in problems ranging from tripping of the circuit breaker at the connection point to severe equipment damage and hazardous conditions for personnel on both sides of the connection.

8.1.3 Islanding

Automatic and manual switching arrangements on the District transmission, Subtransmission, and distribution system are based on the premise that, upon opening a line or section of the District system, it becomes deenergized. Customer Generation equipment that remains energized and connected to the isolated portion of the system or reconnects before service restoration, creates a hazardous condition for utility employees and for this reason, the District does not allow Customer Generation facilities to operate as an island on the District system. The Customer Generation facility must automatically isolate itself from the deenergized portion of the District system in the event of a District outage.

8.1.4 Protective Equipment

The District requires the installation of protective equipment that must be designed and tested to protect the electrical systems and personnel of the Customer Generation facility, the District, and the general public under all operating and maintenance conditions. These requirements are also applicable to automated open transition switchgear capable of closed transition operations via programming or logic changes.

NOTE: All open transition switchgear (either automated or manual via a transfer switch) capable of closed transition operations must meet NEC requirements and must be installed by a qualified licensed electrician.

In some cases, site-specific factors will determine the technical requirement unique to the proposed Customer Generation installation.

8.2 Power Quality Restrictions for Generation

8.2.1 Operating Limits

The following restrictions are provided for information only, and do not necessarily represent District requirements for a specific Customer Generation facility. The District will determine specific operating limits during the course of the District facility approval process. In most cases, District requirements will be consistent with the latest version of IEEE 1547 ‘Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces,’ other applicable standards, and the following:

8.2.1.1 Voltage

The voltage regulation of the Customer Generation must be adequate to ensure any out-of-bound condition will be corrected to within the control limit of 2 seconds. The voltage control limits for the Customer Generation are the ANSI C84.1 ‘A’ range limits (+/- 5%) for the service voltage (see Point of Common Coupling [PCC] in glossary). The Customer Generation must automatically disconnect from the District system in accordance to Table 11, DER response (shall trip) to abnormal voltages for DER of abnormal operating performance Category I of IEEE 1547 and Section 6.4 Voltage.

Class I, II, & III:

Shall Trip Function		Voltage (p.u. of nominal)	Clearing Time (seconds)
Over Voltage	OV2	1.20	0.16
	OV1	1.10	1.0
Under Voltage	UV1	0.70	2.0
	UV2	0.45	0.16

The over voltage one (OV1) clearing time is 1.0 seconds is based on the CBEMA curve for microprocessor based equipment.

8.2.1.2 Voltage Flicker

The Customer Generation operation must not result in objectionable flicker on the utility system for other connected customers at the point of common coupling. Objectionable voltage flicker is defined as, causing equipment mis-operation, or the flickering of lamps at levels irritating to humans. Reference IEEE Standard1547, IEEE 519, IEEE 1453, IEC/TR3 61000-3-7, IEC 61000-4-15, IEC 61400-21.

8.2.1.3 Frequency Control

The frequency requirements of the Customer Generation will be dependent on the class of the facility as listed below:

Class 0:
The frequency of the Customer Generation must not deviate from 59.5 Hz minimum to 60.5 Hz maximum per NERC PRC-024-2. The Customer Generation must automatically disconnect from the District system within 0.16 seconds if the frequency exceeds the tolerance limits.

Class I, II, & III:

Shall Trip Function			Frequency	Clearing Time (seconds)
81O	Over Frequency	OF1	60.5	0.16
81U	Under Frequency	UF1	59.0	2.0
		UF2	57.0	0.16

8.2.1.4 Power Factor

Constant power factor mode with unity power factor setting shall be the default mode of the installed DER unless otherwise specified by the District.

The power factor may be adjusted by the NPPD system operator(s) as conditions change on the NPPD system. If the Generating Facility cannot maintain the voltage set point, the NPPD system operator(s) may require the Generating Facility to reduce its injection into the NPPD system to maintain acceptable voltage levels on the NPPD system.

8.2.1.5 Harmonics

The Total Demand Distortion (TDD) of the current of an exporting Customer Generation must not exceed 5%, measured at the point of common coupling. The harmonic spectrum must not exceed the IEEE 519 limits specified in Table 2 as measured per IEEE 519 and not IEEE 1547.

The TDD of the voltage of a Customer Generation must not exceed 5% at the point of common coupling.

The Customer Generation facility Owner is responsible for the installation and expense of any additional equipment needed to prevent an objectionable increase in the utility system voltage TDD due to operation of the Customer Generation.

8.2.1.6 Export Power Requirements

The quality of the generated AC power depends on the construction of the generator or static power converter. Certain Customer Generation types may produce electrical waveforms that are not clean sinusoidal wave shapes. Low quality power is unacceptable for export to the utility.

Where Customer Generation facilities intend to export power utilizing rotary type AC generators, the generators must have a skewed rotor or winding pitch of approximately 2/3 to ensure clean AC production and low third harmonic generation. Generators exporting power through an Owner’s delta-wye transformer (delta on the generator side) may be allowed to use other winding pitches as the delta winding should trap triple-n harmonics.) (This situation is most common with larger Class II or Class Ill Customer Generation facilities.)

8.3 Protective Equipment

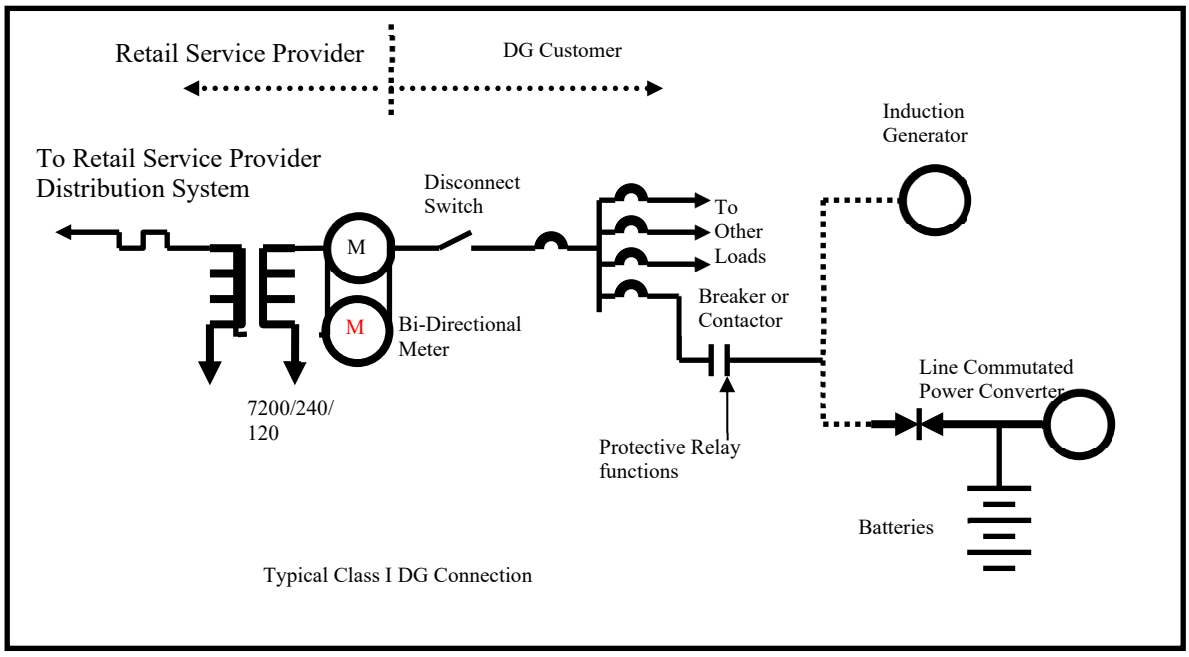
Closed transition operation of Customer Generation on the District system will normally require the installation of certain ‘protective’ equipment. The Customer Generation Facility Owner purchases, installs, and maintains this equipment. This section does not

describe the conditions under which protective equipment is required (refer to 'Classification of the Customer Generation connection' for this information), but outlines the requirements for such equipment and the conditions of its use.

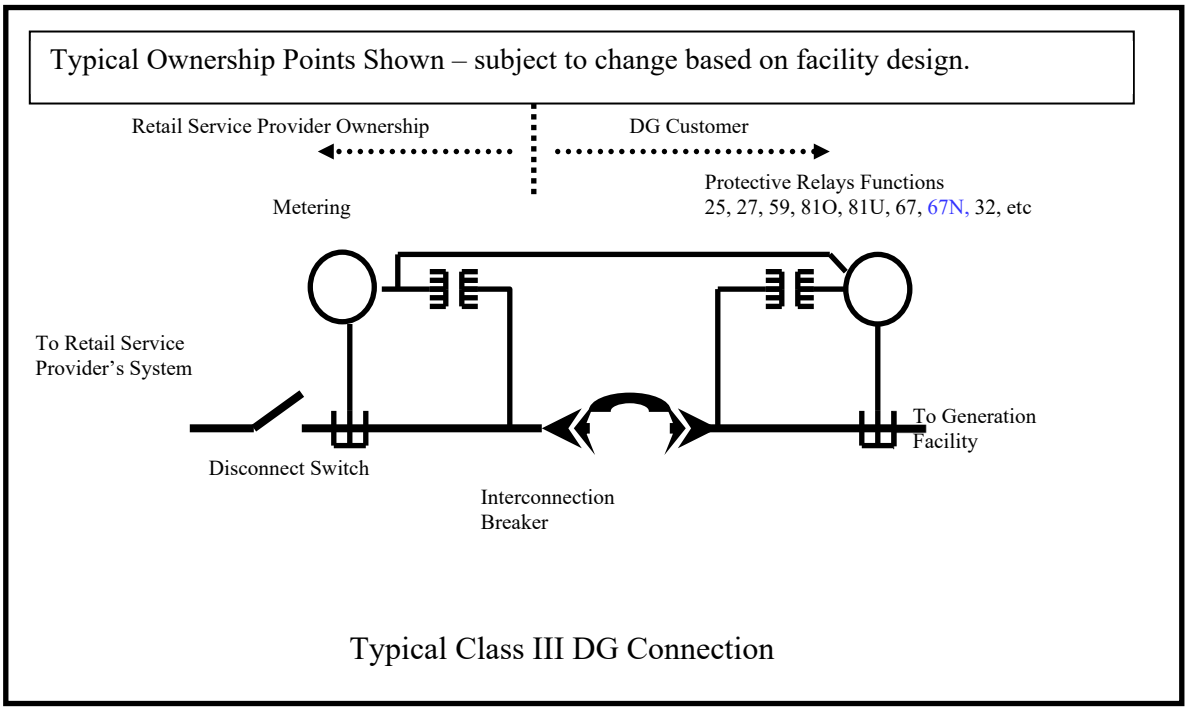
The typical installed location of a connection disconnect switch, connection breaker, District revenue metering, and protective relaying is indicated in the 'Standard Connection Diagram' below. As each Customer Generation facility is approved on a case-by-case basis, actual installed equipment locations may vary.

The District requires a means to be provided for temporary installation of District grounding cables. The grounding cables are intended for protection of District personnel during repair or maintenance operations, and consist of clamp and cable assemblies used to temporarily connect a conductor to ground. The District will review and determine such required locations as part of the proposed protective equipment design review.

8.4 Figure 4. Typical Class I Customer Generation Connection



8.5 Figure 5. Typical Class III Customer Generation Connection



Protective equipment owned by the Customer Generation facility should be maintained and inspected by the Customer Generation facility Owner according to the equipment manufacturer's recommendations and/or industry standards. Procedures should be established for visual and operational inspections and for equipment maintenance and testing. Equipment maintained and inspected should include, but not be limited to:

- Circuit Breaker(s)
- Protective Relaying
- Control Batteries

The District maintains the right to review maintenance, calibration, and operation data of all protective equipment for the purpose of protecting the District system and other District customers. The Customer Generation facility Owner is responsible for providing the necessary test accessories (such as relay test plug, instruction manuals, wiring diagrams, etc.) required to test these protective devices.

8.5.1 Connection Disconnect

Each connection disconnect switch must meet the following requirements:

- Be rated for the service voltage and phasing (i.e., single or three-phase).
- Be rated not less than the ampacity rating of the service entrance equipment.

- Be manually operable and simultaneously open all ungrounded conductors.
- The interrupting rating must be suitable for the available fault current from either the utility or Customer Generation source(s) (whichever is greater).
- The switch will be load break type with arc arrestors and provide a visible means of verifying the switch contacts are in the open position with the switch enclosure open. Switch designs requiring removal of plates, covers, or partial disassembly of the switch to provide visual access to the contacts, are not acceptable to the District.
- The switch enclosure NEMA rating must be appropriate for the specific application and installed location.
- The switch must have provisions for padlocking the switch in the open and closed position and must accommodate a standard District padlock, to be provided by the District.
- The switch must have provisions for grounding all phase conductors and neutrals (on both sides of contacts) to a proper grounding conductor/electrode within the switch enclosure. The District must be able to close and secure the disconnect door or cover with the ground jumpers in place.

NOTE: The switch is not required to be fused. Fused switches are not restricted, but removal of the fuses will not be required to meet the 'visible means of open switch position' described above.

Each connection disconnect switch must be installed as follows:

- The switch enclosure (if conductive) and switch grounding provisions will be grounded in accordance with the NEC and local codes.
- A grounding bar or other grounding point must be provided within the switch enclosure for termination of District grounding cables. The grounding point must allow the District grounding cables to be installed with the switch in the open position and the switch door closed and locked.
- The switch must be installed in a location readily accessible to District personnel (i.e., be erected at a drive-up location). Locked fences or other permanent barriers must not restrict District access to the switch. Fences may be secured with a chain and series connected District and Owner padlocks, so either District or the Owner has access without the other present.
- The switch will normally be installed at the point of common coupling. In this location, when open, it will electrically separate the Customer Generation facility electrical system from the District system (excluding the neutral conductor).
- Where installed in the vicinity of similar disconnect switches, the switch must be clearly labeled as the Generator Disconnect Switch so as to be readily identifiable by District personnel.

Each connection disconnect switch is subject to the following conditions:

- Must not serve a dual role as both the District required connection disconnect switch and the NEC-required service disconnecting means, as additional NEC service

entrance overcurrent protection devices will not be allowed to bypass the connection disconnect switch.

- Is under the sole control of the District, unless the District should release the switch for Customer Generation Owner operation. The Customer Generation Owner must not remove any District padlocks or District safety tags. The District will be allowed unrestricted access to the switch and will operate the switch under conditions and at times deemed appropriate by the District. Examples of conditions under which the District may operate the switch include:
  - The District performing maintenance work on the District system.
  - The District system emergency.
  - Discovery of a condition involving the Customer Generation facility's equipment or operation which threatens the District system.
  - Failure of the Customer Generation facility to provide maintenance and testing reports when required.
  - The Customer Generation facility's generating equipment interferes with other District customers or with the operation of the District system.
  - The Customer Generation facility's generating equipment or protective devices are discovered to have been modified without the approval of the District.
  - Discovery of parallel operation of unapproved generating equipment.

- Use of the switch is to provide positive separation of the Customer Generation source from the District system to effect maintenance or repairs to the District system. The District will normally attempt to notify the Customer Generation facility Owner or operator prior to operation of the switch, but the District reserves the right to operate the switch without Owner notification.
  - If the District should not open the Connection Disconnect Switch, such act will not serve to relieve the Customer Generation facility Owner of any liability for injury, death, or damage attributable to the negligence of the Customer Generation facility Owner.
  - Desire of the Owner to operate the switch for maintenance, testing, or construction purposes will require them to contact the District for temporary removal of the padlock. The Owner or the Owner's representative will operate the switch for these conditions. Upon completion of their activities, the Owner must notify the District to reinstall the padlock with the switch in either the open or closed position, as left by the Owner. For reoperation of the switch, the Owner must contact the District to repeat the process.

8.5.2 Connection Breaker

Each connection breaker must meet the following requirements:

- Circuit breaker construction is normally required for the connection breaker.
- Be draw-out type, vacuum, or SF6 interrupting with provisions for locking the device with the breaker open and/or in the unracked position. Provisions must be made to open the voltage sensing circuits when the draw-out breaker is in the open position (i.e., fused cutouts).
- Be rated for the service voltage and phasing.
- Carry an ampacity rating not less than that required, in accordance with the National Electrical Code (NEC).
- Be designed to open all ungrounded conductors simultaneously.
- Be rated for the available fault current from either the utility or Customer Generation source(s) (whichever is greater).
- The breaker enclosure must be suitable for its installed environment.
- The breaker must have provisions for grounding all phase conductors and neutrals to a proper grounding conductor/electrode, as indicated in the 'Standard Connection Diagram'. If a grounding rack is provided (for draw-out breakers) to meet this requirement, the rack should be stored and available at the breaker location.
- For three-phase service, the trip and close coils of the breaker must be direct current (DC) type.

Each connection breaker must be installed as follows:

- The breaker will normally be the first breaker on the customer side of the District revenue meter.
- While the actual protective functions/relaying required for each Customer Generation facility must be determined, the protective functions/relaying required will normally monitor conditions at this breaker and operate this breaker in the event a trip is required.

Each connection breaker is subject to the following conditions:

- If required, a trip signal may be sent as part of a Direct Transfer Trip (DTT) or other schemes. When a trip signal is received from the District to open the Customer Generation facility connection breaker, the signal is intended to supplement, but not replace, protective relaying installed at the Customer Generation facility. The failure of the District signal to open the connection breaker will not serve to relieve the Customer Generation facility Owner of any liability for injury, death, or damage attributable to the negligence of the Customer Generation facility Owner.
- Where a draw-out connection breaker is installed, if required, a crane must be provided and available at all times at the breaker location for use with draw out breakers and/or test racks.

- If a draw-out type connection breaker is not provided when the District must perform work requiring the breaker path to be visibly open and the breaker grounding provisions utilized (as indicated in the 'Standard Connection Diagram'), the District may require 1) all Customer Generation facility generation unit disconnects be visibly open and locked (by the District) in the open position, or, 2) the connection breaker be physically unbolted and removed from its installed location, and later reinstalled at the completion of District work by a qualified electrician at the expense of the Customer Generation facility Owner.
- While the actual protective functions/relaying required for each Customer Generation facility must be determined, the breaker is required to have synchronization capability, to open for abnormal frequency conditions, and to open for any loss of utility voltage. These requirements help prevent the electric generation from back feeding and energizing the utility system in the event of a District outage. The breaker can only be closed if the utility voltage is nominal and stable and the synchronism check relay permits.

8.5.3 Protective Functions/Relaying

- Customer Generation facility electrical system designs often include two groups of protective relays. One group is assigned the task of protecting the utility system from the Customer Generation (these relays usually operate the connection or main service breaker). A second group is responsible for the protection of the Customer Generation facility generation equipment (these relays usually operate the main generator breaker[s]). Where relay information, settings, drawings, etc., are to be submitted to the District for review, only the information pertaining to the first group is required. The Customer Generation applicant submits the generator relay settings to the District for reference purposes only. The Customer Generation Owner or their representative should note careful setting coordination is required between these two relay groups. This coordination ensures proper operation of the customer side system. Some connections will not include a separate relay group for utility side protection. The generation protection group will also provide utility-side protection (by tripping the main generator breaker or through shutdown of the inverter output of a direct energy converter).
- District protective relay requirements tend to become more stringent in proportion to the potential impact of a Customer Generation facility on the District system (and other District customers). This standard should be considered a guide in regard to protective relaying. In most cases, District requirements will be consistent with the latest version of IEEE 1547 'Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces,' and other applicable standards. The District will determine specific protective relay requirements during the Customer Generation impact study. Upon review of the Customer Generation applicant's design for the proposed parallel installation, the District may require changes to the protection scheme. The coordination of the relay may be delayed to allow the generation to trip off prior to reclosing, but would be reviewed on a case by case basis.

- The District may refuse the use of certain protection methods, equipment, equipment grades, or manufacturer's products. The District retains the right to approve or reject the type of protective relays/devices used and the relay settings. The protective relays shall be microprocessor-based.
- The District requires the protective functions/relaying operate as intended under all conditions, including for a loss of the normal power source serving the protection scheme. The Customer Generation facility protection system must account for this possibility in its design, and utilize a Customer Generation power supply with battery backup or other means of assuring proper operation for all conditions.
- Many microprocessor based relays are capable of external indication of a relay internal failure or alarm condition. The District may require such relays to trip the connection (or generation) breaker immediately upon relay alarm or failure indication, or act to prevent parallel operation of generation with the District until the alarm or failure condition is corrected.
- The relays must monitor all ungrounded conductors. For example, protection of a three-phase system using single-phase relaying is unacceptable.
- The Customer Generation facility Owner is responsible for synchronization of Customer Generation facility generation to the District System. The Customer Generation facility must be in synchronism with the utility system just prior to closing the appropriate Customer Generation facility sync-protected circuit breaker (often the connection breaker) and during the entire period of parallel operation. Protection function 25 (synchronism check) is for all classes. Inverter based resources (IBR) do not require protective function 25.
- The District does not allow islanding (see glossary) of Customer Generation facilities on the District system. The Customer Generation facility must isolate itself from the District system in the event of a District outage.
- Protective relays can generally be categorized into two major groups: industrial grade and utility grade. Industrial grade may be considered PLC's or protection functions integral to the control system of small generation equipment. The District requires Customer Generation facilities with net generation above 250 KW use utility grade relays (meeting IEEE/ANSI C37.90 design standards—see glossary). Any Customer Generation from 50 KW up to 250 KW may also require utility grade relays based on the impact to the system. Utility type test switches must be installed in conjunction with utility grade relays.
- Minimum protection function requirements, regardless of class or size, include minimum 27, 59, 81O, and 81U protection functions (see glossary).

Minimum protection function requirements are listed in the table below:

CLASSES	MINIMUM PROTECTIVE FUNCTIONS
Class 0 Induction Generator / Line Commutated Inverter greater than 25 kW	None
Class I Line Commutated Inverter greater than 25 kW	27, 59, 81O, 81U
Class II Synchronous Generator/ Forced Commutated Inverter Less than 5,000 kW	27, 59, 81O, 81U, 67, 67N
Class III Synchronous Generator/ Forced Commutated Inverter	27, 59, 81O, 81U, 67, 67N, 32,
All Induction or Synchronous Generators	25

(See glossary for device designations).

- Other functions, which the District may require, include (but are not limited to): 21, 32 (three-phase), 46, 67 (all phases), 67G/67N, and 68. The District may also require the following items:
  - Spare dry contacts in the Customer Generation control system for tripping and/or monitoring of the Customer Generation facility.
  - Communications channel(s) with communications equipment.
  - A remote-trip system (the District sends a signal to trip the Customer Generation facility connection breaker such as DTT).
  - Duplicate/redundant/backup relays.
  - Or other specialized equipment.

- 'Vector Jump/Step Frequency,' 47, 50, 50G, 50N, 51, 51G, 51N functions are not usually required by the District, but if installed, settings information and curves are required to be included in submittals for review.

9.0 DISTRICT SYSTEM REQUIREMENTS

9.1 Metering and Telemetry Equipment Metering

The District uses two styles of metering equipment for traditional utility revenue metering, 1) self-contained meters and 2) instrument transformer meters. Self-contained meters are a series-connected measurement device, and therefore are an integral part of the power circuit where removal of the meter interrupts the power flow. Self-contained meters usually are not rated over 320 amps. For capacities beyond 320 amps, and/or nominal voltages 480 volts and higher, instrument transformer meters are typically installed. When instrument transformer meters are used, current transformers (CT's) and voltage transformers (VT's) send an output signal to the peripheral meter, and the meter is not an integral part of the power circuit.

The pricing difference between import and export transactions requires special metering to measure energy flows. Import/export connections require metering equipment that is capable of separately recording the import and export transactions.

The facility Owner is responsible for the installation of the appropriate meter socket for self-contained import/export meters. The District will provide appropriate metering equipment enclosures for instrument transformer import/export meters. The District will determine and advise the Owner of such meter requirements for facilities on a case-by-case basis. The District may determine that a power quality (PQ) rated meter is required based on the type or size of the Customer Generation facility.

Five terminal socket-based adapters are acceptable for use for net metering applications up to the rated ampacity of the unit. Currently, the only approved socket-based adapter is the ConnectDER®. Other socket-based adapters may be acceptable, but will require approval in writing in advance of the application.

The District will own and maintain multi-function, bi-directional import/export meters for self-contained and instrument transformer metering applications. These can be installed parallel to the Retail Service provider's Customer Generation meter.

Larger Customer Generation installations may require additional metering equipment, including recorders, additional metering accuracy CT's (possibly installed at the output of Customer Generation equipment), and telephone/fiber line(s) for District access to District equipment. Such requirements will be communicated to the Owner during the impact study process. A GPR (Ground Potential Rise) study may be required for installing a telephone/fiber line in a Customer Generation facility.

Instrument Transformers shall be owned and maintained by the host utility and shall include three (3) each, phase to ground primary connected Voltage Transformer (VT) and three each line connected Current Transformer (CT), with polarity markings oriented toward the power system grid. All CTs shall meet 0.15S accuracy requirements of IEEE C57.13-2016 Accuracy Standards for High Accuracy Extended Range Current

Transformers, Table 8. All VTs shall meet 0.3 accuracy requirements of IEEE C57.13-2016 Accuracy Standards for High Accuracy Voltage Transformers, Section 7.3.1.

The Customer Generation owner shall provide engineering design which would accommodate a location for the placement of NPPD owned revenue meter and communications equipment. Customer will also provide 120 volt station power circuit in said location for NPPD meter and communication equipment. The design for the metering shall also include acceptable isolation points to maintain the metering equipment.

The communication required to send the Metering or Telemetry data could include a land line, fiber, radio, or cell modem. If a cellular modem is utilized, it would be owned and maintained by NPPD. If modem is required for curtailment scheme for the customer owned generation, the owner will agree to pay for ½ the present value costs for the modem and cell service.

For class I, II, or III facilities, it is requested that 10 days prior to any planned maintenance please contact **customergeneration@nppd.com** .

9.2 Telemetry

Telemetry is the real-time, instantaneous monitoring of conditions at the Customer Generation facility by the District. Telemetry is accomplished by interfacing Customer Generation facility equipment or systems with the District Energy Management System (EMS) and District Advanced Distribution Management System (ADMS).

The District requires real-time telemetry for Customer Generation installations greater than or equal to 500 KW. The requirement for Telemetry may be lowered based on Energy Supply needs such as for multiple adjacent Customer Generation facilities served from same feeder that combined would aggregate to 500KW or above.

When telemetry is required, the Customer Generation facility Owner and the District must coordinate the details of the required communications system and equipment for telemetry.

9.3 Service Transformers

All new and most existing District three-phase service transformers are wye-wye type (installed grounded wye-grounded wye). The District will typically own and install wye-wye transformers for service to three-phase Class I Customer Generation connections (refer to ‘Classification of the ‘Customer Generation Connection’ in this standard). The District prefers wye-wye service transformers for Customer Generation facilities for technical reasons, and will often want to replace or reconfigure transformers that are not wye-wye configuration.

Existing delta-delta or ungrounded wye-delta service transformers installed at Customer Generation facilities will require reconfiguration of the transformers to wye-wye or the installation of utility side voltage unbalance protection equipment. In some cases,

upgrading of the District transformer insulation levels and lightning arrester ratings to a higher voltage may be required. Installing 3-phase inverters on Open Delta transformer banks is not allowed. The Customer Generation facility Owner is responsible for the installation and material costs of such equipment (see 'Requirements for Closed Transition Operation,' 'Connection Expenses' in this standard).

Class III connections typically use a wye-delta step-up transformer (Customer Generation facility owned, with delta on the generator side) for connection to the District electric system.

To provide isolation and minimize possible adverse effects on other District customers from Customer Generation facility generation, all Customer Generation facilities with three-phase electric service must be connected to the District through a dedicated service transformer. Such Customer Generation facilities may not share the secondary or load side of the District service transformer with other District customers.

Customer Generation facilities with single-phase electric service where the Customer Generation is utilizing nonsynchronous inverter technology requiring connection with the utility to maintain synchronous operation will not be required to have a dedicated service transformer. All other single-phase Customer Generation installations will require a dedicated service transformer.

The District will determine the transformer connection and grounding configuration required. While in the facility design stage, the Customer Generation facility Owner should always verify with the District the details of the electric service (voltage, phase, ampere rating, etc.) and the service transformer winding configuration.

9.4 Automatic Reclosing

It is District practice to apply automatic reclosing of circuit protective devices in the substation (see glossary) to transmission and distribution circuits.

Existing automatic reclosing schemes for the District distribution circuits assume the circuit is dead (de-energized) prior to reclosing. The protective relays and other controls do not employ voltage check, synchronization check, or phase checking functions. The introduction of a induction or synchronous Customer Generation facility may require the addition of equipment and modification of the protection scheme to the District circuit serving the Customer Generation facility. The cost of this additional equipment and its installation are the responsibility of the Owner of the new Customer Generation facility (see 'Connection Expenses' in this standard). The added functions are intended to prevent reclosing of the District protective devices in the event a Customer Generation facility is energizing the District circuit by operating in an 'islanding' condition (see glossary).

Those applying for Customer Generation facility approval will be informed when this equipment is required and the Customer Generation Owner is responsible for those costs.

The Customer Generation facility must not energize a de-energized District circuit. It is the responsibility of the Customer Generation Owner to ensure the Customer Generation equipment does not allow operation in an 'islanding' condition. Should the utility source be lost or a fault occur on the utility side of the connection, the local Customer Generation must disconnect itself from the District system by tripping the connection breaker prior to automatic reclosing of the District protective devices. The District assumes no responsibility for damage to Customer Generation equipment due to out-of-phase reclosing.

The amount of reclosing time delay on District circuits varies depending on many factors. While in the facility design stage, the Customer Generation facility Owner should always verify (with the District) reclosing details for each Customer Generation facility service.

9.5 ATO Service

ATO (Automatic Throw Over) service is common to hospitals and some other types of customer facilities requiring a backup District circuit in the event of a District circuit outage.

Many technical issues arise when it is proposed Customer Generation operate in closed transition with the District while served from an ATO service.

ATO service is a complicating factor to the District Customer Generation approval process. Should modifications to the District system or equipment be required, the Customer Generation facility Owner is responsible for the labor and material costs of such modifications (see 'Requirements for Closed Transition Operation', 'Connection Expenses' in this standard).

9.6 Single-Phase Devices

The District may require replacement of single-phase overcurrent devices (line fuses, single-phase automatic circuit reclosers, single-phase line switches) on the District circuit between the District substation and the Customer Generation facility service entrance. These components would be replaced with three-phase devices to minimize the possibility of single-phasing a three-phase Customer Generation facility. If required, the cost of the removal of single-phase devices and the addition of three-phase devices (equipment and installation) are the responsibility of the Owner of the new Customer Generation facility (see 'Connection Expenses' in this standard). In some cases, these single-phase devices will be left in place.

Regardless of whether any single-phase devices are replaced with three-phase devices, the Customer Generation Owner is responsible for protecting Customer Generation equipment from the effects of excessive negative sequence currents, system imbalance effects, or loss of utility phase/utility single-phase conditions. The District assumes no responsibility for damage to Customer Generation equipment due to these effects.

10.0 CONNECTION EXPENSES

The District's maintenance and operation procedures are based on a single source serving the electric system. Connection of additional generation or other modifications to the electric system will necessitate modification to these procedures. Often, the introduction of Customer Generation to the utility system requires capital expenditures for additional utility equipment. The modified procedures and additional utility equipment increase utility costs without providing benefits to other utility customers. In such cases, the expenses for additional District procedures, equipment, maintenance, labor, and other related costs that are over and above the expenses for a non-generating customer must be paid to the District by the Owner of the Customer Generation facility.

These reimbursable costs are separate from Customer Generator obligations to purchase, install, and maintain District required connection equipment installed at the Customer Generation facility, as well as the cost of professional engineering services and maintenance testing to satisfy District requirements.

The following expense categories are examples of items reimbursable to the District:

- Operating expenses, including communication circuits.
- Study, analysis, and related expenses.
- District assistance in securing regional regulatory authority acceptance of the Customer Generation facility.
- Modifications to the District system including related material and labor.
- Protective device (District owned) installation/equipment cost and related labor.
- District costs for Customer Generation facility design review, equipment inspections, and witness testing.

Changes to the District system or the addition of other Customer Generation facilities in the vicinity may require modifications to the existing Customer Generation facility connection. If such changes are required, the existing Customer Generation facility will be subject to future charges for these modifications.

Also, a Customer Generation installation results in increased utility maintenance costs in the event of an extended outage on the utility circuit serving the Customer Generation facility to safeguard District repair crews. The District will isolate the Customer Generation facility from the District system by opening the connection disconnect(s) before restoring service to the disabled circuit. The District will return to the Customer Generation facility and close the connection disconnect(s) after the utility circuit is restored. These additional steps are only required for facilities with connected generation, but potentially delay restoration of service to all customers of the utility circuit.

11.0 CONTACT INFORMATION

For Class 0, Class I, and smaller Class II installations, the District requires daytime and nighttime phone numbers for emergency contact purposes. Minimal additional generation Owner contact information is required. The contact person(s) should contact the Nebraska Public Power District Call Center at Norfolk whenever the District electric system has a service interruption affecting their generation equipment.

For larger Class II and Class III installations, the District requires a 24 hour/day, 365 day/year phone number for after hours and emergency contact purposes. The designated Customer Generation facility contact person(s) should have responsibility for and authority over operation of the generation and be able to provide information regarding facility events, equipment status, and relay target and alarm information upon the District's request. Also, the contact person(s) should notify the District whenever:

- Problems with generation equipment are detected that could result in mis-operation of generation protection or other generation equipment.
- The generation has tripped off-line during parallel operation with the District system.
- Generation equipment problems are believed to have resulted in an outage to a portion of the District system.
- The Customer Generation facility intends to initiate abnormal switching to parallel the generation with the District system.

Under certain circumstances, the District may determine additional contacts are required.

12.0 REFERENCES

Customer Owned Generation Application for NPPD Approval to Connect Distributed or Local Generation. **Nintex Automation Cloud**

IEEE 1547, Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

IEEE 1547.1, Interconnection System Testing.

NERC PRC-024-2, Generator Frequency and Voltage Protective Relay Settings
https://www.nerc.com/pa/Stand/Reliability%20Standards/PRC-024-2.pdf

NPPD Facility Connection Requirements:
https://docs.nppd.com/FacilityConnectionRequirements.pdf

13.0 ATTACHMENT 1 - GLOSSARY

Accredited Generation: Generation capability recognized as meeting requirements for 'accreditation' established by the regional regulating authority charged with regulation of power transactions between utilities and independent power producers. Most generation installed primarily for the export and sale of electrical power (typically Class III Customer Generation facilities) meet this definition. See 'Non-Accredited Generation'.

Cogeneration: The concurrent production of electricity and heat, steam or useful work from the same fuel source.

Closed Transition: For the purpose of this standard, it is operation of two or more separate electrical generation sources while their outputs are tied together—see 'Parallel.'

Closed Transition Transfer: In this scheme, a facility's load is transferred from Source 1 to Source 2 and vice-versa while momentarily connecting the two sources together in 'closed transition.' The facility's load is not interrupted during the transfer process. Customer switchgear can typically be programmed or reprogrammed to operate in this manner.

Connection Breaker: See the 'Protective Equipment' section in this standard.

Connection Disconnect: See the 'Protective Equipment' section in this standard.

Connection Point: The connection point of the District to any Customer Generation facility is the point at which the District system connects to devices, conductors, or equipment of the Customer Generation facility, as determined by the District. This point will normally be the 'point of common coupling' as defined in 'IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems,' IEEE Standard 519. The service entrance voltage is typically defined by the voltage at this point.

Current Transformer (CT): A transformer intended for metering, protective or control purposes, which is designed to have its primary winding connected in series with a circuit carrying the current to be measured or controlled. A current transformer normally steps down current values to safer levels. A CT secondary circuit must never be open circuited while energized.

Customer Generation (or Customer Generator or CG): Any Distributed Generation and Local Generation.

DEC: Direct Energy Converter—see 'Generation Equipment.'

Direct DC Tripping: The wiring from the trip output contacts of the protective relay(s) must be connected directly to the trip coil of the connection circuit breaker, such that the protective relay alone can initiate a trip of the breaker. The trip circuit path for utility protection must not pass through (or be dependent upon) the contacts of a computer, PLC,

or other foreign intelligent device not installed for the sole purpose of protection. Test switches, 94/auxiliary tripping relays, and 86/lockout relays are allowed in the trip circuit and are not considered foreign to the protection system. A by-product of direct DC tripping is all relay targets are functional as intended by the relay manufacturer.

Distributed Generation (or Distributed Generator or DG): A generator (or group of generators) designed to produce electrical energy to serve local load, typically located on the end-use customer's side of the meter. If more than one generator is located in the same installation, use the aggregate nameplate rating of all generators in determining the applicable requirements and provisions.

Export: To supply power to the electric utility from Customer Generation—the customer generation facility 'exports' power to the utility.

Export-only: Operation of Customer Generation in closed transition with the utility, in which the entire capacity (or nearly the entire capacity) of the Customer Generation facility generation equipment is used for intentional 'export' back into the utility system. This definition would most often apply to Class III Customer Generation connections.

Facilities Study / System Impact Study: A system impact study is designed to identify and detail the electric system impacts that would result if the proposed Customer Generation Project were connected without project modifications or electric system modifications, focusing on the adverse system impacts identified in the feasibility study. A system impact study shall evaluate the impact of the proposed connection on the reliability of the electric system.

Feasibility Study: Feasibility Study is designed to identify any adverse system impacts that would result from connection of the Customer Generation project. Examples of such negative impacts would include exceeding the short circuit capability rating of any breakers, violations of thermal overload or voltage limits, and a review of grounding requirements and electric system protection.

Import/Export: Two-way power transfer between the utility and a Customer Generation facility while operating in closed transition. The direction of power transfer is usually dependent upon the level of Customer Generation facility load and the level of Customer Generation output. If the Customer Generation facility is not operating, the facility may be importing power from the utility to serve facility load. If the Customer Generation facility is operating but not generating more than the Customer Generation facility load, the facility is still importing utility power. If the Customer Generation facility is generating power in excess of the Customer Generation facility load, the excess power is exported to the utility.

Import: To accept power from the electric utility in the traditional fashion to serve customer load—the customer 'imports' power from the utility.

Import-only: Operation of a Customer Generation facility in a closed transition with the utility in which any excess Customer Generation capacity is not allowed to be exported to the utility. Note in some cases the Customer Generation capacity may be low relative to the Customer Generation facility load, or the Customer Generation capacity may exceed the Customer Generation facility load, but at no time is power allowed to be intentionally 'exported' back to the utility.

IPP: Independent Power Producer.

Island or Islanding: For the purposes of this standard, it is the undesirable condition where the 'normal' utility electrical source has been disconnected from and no longer serves all or part of a utility circuit, and all or part of the utility circuit load is being served for an extended period (beyond a few seconds) by a Customer Generation facility. Such a circuit is operating as an electrical 'island,' independent from the utility.

Isolated: Type of connection and operation in which a Customer Generator and the utility's electrical system are never operating in Sustained Parallel or Momentary Parallel.

Local Generation: A generator (or group of generators), designed to produce electrical energy for wholesale sales, that is not classified by NPPD as Distributed Generation. If more than one generator is located in the same installation, use the aggregate nameplate rating of all generators in determining the applicable requirements and provisions.

Momentary Parallel: Type of connection and operation in which a Customer Generator and the utility's electrical system are tied together and operating in Parallel for no more than 100 milliseconds.

Network, Grid: For the purpose of this standard, it is defined as a configuration of the distribution system where the secondary windings of multiple distribution transformers are tied in parallel, while the transformer primaries are served from more than one distribution circuit. Each transformer secondary is protected using a 'network protector'. Multiple customers tap into the same secondary connection, usually at 208V or 480V, three-phase.

Network, Spot: See 'Network, Grid' above. For the purpose of this standard, the 'Spot' network is essentially the same as a 'Grid' network, but the 'Spot' network serves only one customer facility.

Non-Accredited Generation: Generation which is not 'accredited' by the regional regulating authority charged with regulation of power transactions between utilities and other independent power producers. Most generation installed primarily for local facility load support (and may have export capability) meet this definition. See 'Accredited Generation'.

Open Transition: For the purpose of this standard, it is operation of two or more separate electric generation sources while their outputs are <u>not</u> tied together—they are operating separately from one another, with no electrical tie between the two or more systems (other

than ground). Customer switchgear can typically be programmed or reprogrammed to operate in this manner.

Open Transition Transfer: In this scheme, a facility's load (or portion of it) is transferred from Source 1 to Source 2 and vice versa without momentarily connecting the two sources together. Here, the facility's load is interrupted momentarily during the transfer process. Typical emergency standby system automatic transfer switches are open transition type. Customer switchgear can typically be programmed or reprogrammed to operate in this manner.

Parallel Operation (Duration of): The amount of time electric generation will operate in parallel (or 'closed transition') with the utility system will help determine the District requirements for the Customer Generation facility. For the purpose of this standard, closed transition operation is either momentary or sustained. Momentary closed transition–used only for synchronized closed transition transfer of Customer Generation facility load from one source to another source—Sustained Closed Transition connects the two power systems to remain connected indefinitely, as long as synchronous operation is maintained.

TYPE OF CLOSED TRANSITION OPERATION	DURATION OF PARALLEL OPERATIONS	DISTRICT REQUIREMENTS FOR THE CUSTOMER GENERATION FACILITY
Momentary*	< 100 milliseconds	Synchronism check on transfer connection disconnect. The Customer will not modify the controls without prior notification to the District.
Sustained	> 100 milliseconds	All District Customer Generation Standard requirements and additional requirements, as determined by NPPD as below*.

* Determination as to whether the Customer Generation equipment to be installed is the 'momentary' type above or not will be made by the District. A Customer Generation facility design proposal using a 'closed transition transfer switch' may be approved as 'momentary.' Customer Generation transfer equipment approved as 'momentary' must be designed, manufactured, and listed for use as 'momentary' transfer equipment, and is not designed for 'sustained' parallel operation. Any change to transfer equipment configuration via programmable electronic controls, must be District-approved via reapplication of the Customer Owned Generation Application. Note 'momentary' type of operation is still closed transition operation, and as such is not approved for applications involving network service (see 'System Issues, Network Service' in this standard). Automated switchgear capable of closed transition operations via programming or logic changes must meet the protective requirements and stipulations for sustained connections.

The 'momentary' connection, or closed transition transfer, can result in a large load suddenly being applied to the Customer Generator facility generation. This 'step-loading'

can result in frequency and voltage disturbances that may be unacceptable to the Customer Generator facility load—the generator should be properly sized and selected to help prevent such power quality problems.

Peak Load: The maximum electric load consumed or produced in a stated period of time.

Peak Shaving: Generation operation which results in reducing a facility's peak load (as seen by the utility) or demand.

Point of Common Coupling (PCC): (IEEE 1547) The connection point on an electric power system where the electric system is intentionally connected to a public transmission and/or distribution system and at which point performance requirements are defined.

Potential Transformer (PT): A transformer intended for metering, protective or control purposes, which is designed to step down voltage values to safer levels.

Reclosing/Automatic Reclosing: A common utility practice, it is an attempt to quickly restore electric service to de-energized overhead power lines by re-applying power to the line very soon (0.33 to 5 seconds) after the line has cleared (become de-energized) due to a fault. In sequence: a fault occurs on a line, all line breakers open to clear the fault (de-energizing the line), after a brief delay line breaker(s) close (to re-energize the line), and the line is returned to service. This practice is based on the fact most faults on utility overhead electric lines are of a temporary nature, and as such, the line is clear of faults and ready to be re-energized almost immediately after the fault event.

SPC: Static Power Converter—see 'Generation Equipment' in this standard.

Sustained Parallel (or Parallel): Type of connection and operation in which a Customer Generator and the utility's electrical system are tied together electrically, operating at matching phase rotation with matching voltage and frequency, and are electrically synchronized with each other.

Synchronism: Expresses the condition across an open circuit wherein the voltage sine wave on one side matches the voltage sine wave on the other side in frequency and amplitude without phase angle difference.

System Impact Study / Facilities Study: A system impact study is designed to identify and detail the electric system impacts that would result if the proposed Customer Generation Project were connected without project modifications or electric system modifications, focusing on the adverse system impacts identified in the feasibility study. A system impact study shall evaluate the impact of the proposed connection on the reliability of the electric system.

Utility Grade Relaying: Relays meeting IEEE/ANSI 037.90 design standards. Generally such devices are designed first and foremost for use as a utility protective relay, are for

high-speed use, meet utility standards for construction, and are the product of a recognized utility relay manufacturer.

21: Distance function. The distance relay function operates when the circuit impedance, reactance, or admittance increases or decreases beyond a predetermined value. This relay function is not a standard interconnection relay requirement but may be required by the District in certain situations.

25: Synchronism or synchronism check function. The function operates to close a breaker when two AC sources are within the desired limits of frequency, phase angle, and voltage to permit or cause the paralleling of the two sources.

27: Under voltage function. This function operates for specified under voltage conditions. An operation of this relay function usually results in a trip signal to the interconnection breaker(s).

32: Directional Power Relay/Reverse Power Function. The directional power relay operates on a desired value of real power flow (watts) in a given direction. This relay will initiate a trip signal once the reverse power setting is exceeded. The reverse power limit of this relay is typically set for the maximum export limit (plus a safety margin) for import-only or import/export installations.

46: Reverse-Phase or Phase-Balance Current Relay/Negative Sequence Overcurrent Function.

47: Phase-Sequence or Phase-Balance Voltage Relay/Negative Sequence Overvoltage Function. Typical DG-side protection for phase sequence and from loss-of-phase.

50: Instantaneous overcurrent function.

50G/50N: Instantaneous ground/neutral overcurrent function.

51: Inverse time overcurrent function—often integral to the interconnection breaker.

51G/51N: Inverse time ground/neutral overcurrent function.

52: Circuit breaker (ac).

59: Overvoltage function—this function operates for specified overvoltage conditions. An operation of this relay function usually results in a trip signal to the interconnection breaker(s).

67: Directional overcurrent function—this relay function is intended to operate for a fault on the District system and trip the interconnection breaker.

67G/67N: Directional ground/neutral overcurrent function—this relay function is intended to operate for a fault on the District system and trip the interconnection breaker.

68: Out-of-step function.

81: Frequency function.

81O/U: Over/under frequency function—the frequency relay function operates for specified variances from the normal system frequency.

81R: Rate-of-change frequency function.

86: Lockout relay, either manually or electrically reset. Where references are made to lockout relays, they should be assumed to be manually reset unless indicated otherwise.

94: Auxiliary tripping relay.

Wheeling: The use of transmission or distribution facilities of utility (or utilities) B to transmit power from utility (or Customer Generation facility) plant A to utility (or customer) C load.